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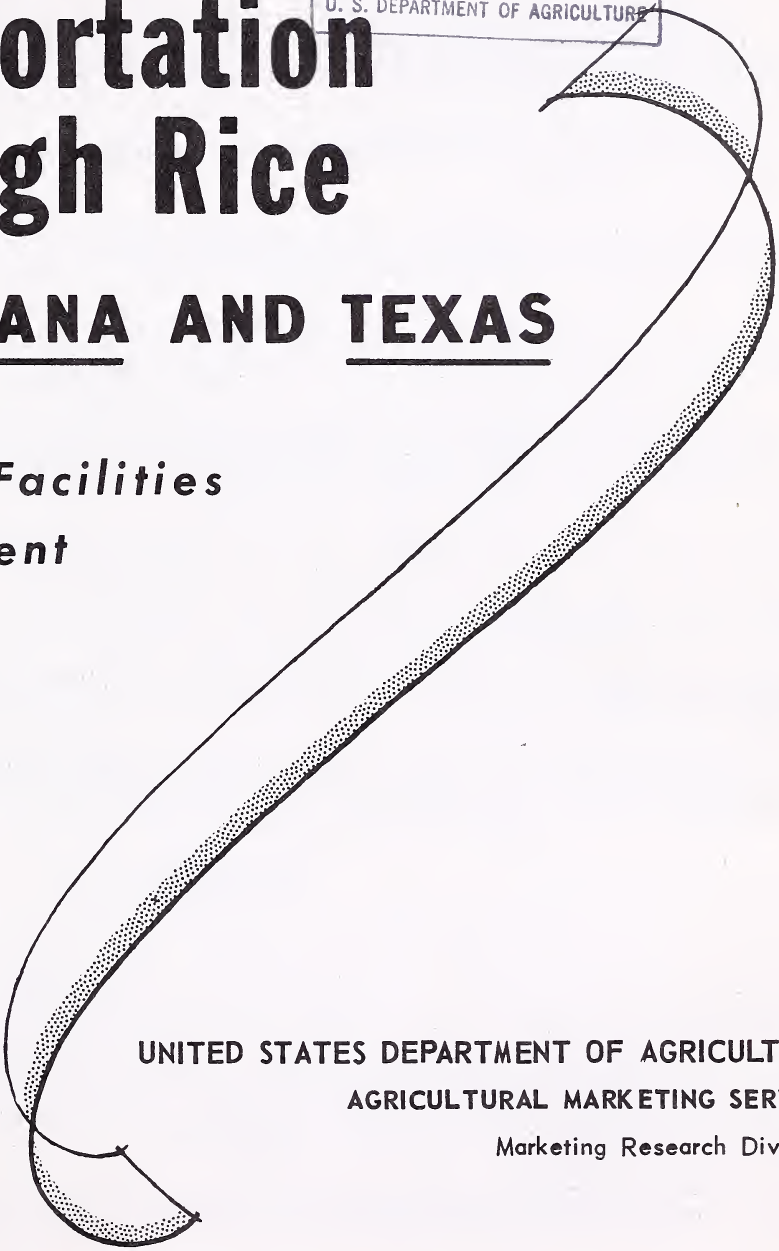
# Railroad Transportation of Rough Rice

## *in* LOUISIANA AND TEXAS

### *A Study of Facilities and Equipment*



UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE
Marketing Research Division

Washington, D.C.

Marketing Research Report No. 136
September 1956

## PREFACE

The favorable outlook for eliminating sack handling of rough rice in Louisiana and Texas, and complete conversion to bulk storage and handling, is important to the railroads. This study compares the time and labor required by various methods to load and unload carloads of rough rice, and shows the increases in bulk storage capacity in recent years. It shows how bulk shipments can contribute to improved car utilization by reducing car detention and turnaround time; and analyzes the use of covered hopper cars for bulk rice traffic in Arkansas.

Assistance of the following organizations and individuals in conducting this study is gratefully acknowledged:

The Association of American Railroads and Mr. H. C. McElree, AAR Car Service Agent, participated in the field survey and analysis of car utilization in Arkansas.

Chicago, Rock Island & Pacific Railroad officials, Mr. J. O. Hunt, Agent, Stuttgart, Ark., and Mr. R. H. Anderson, Superintendent of Transportation, Chicago, Ill., assisted in compiling the car-days data on covered hopper cars.

Officials and employees of railroads in Houston, Tex., the Southern Pacific, Santa Fe, Missouri Pacific, and Houston Belt & Terminal Company, assisted in checking the detention records of 2,886 carloads of rough rice received by rice mills in Houston.

The Rice Millers' Association, New Orleans, La., furnished the data which show the effect of bulk rough rice handling upon milling operations. Appreciation is also expressed to the many individual rice mills, drying plants, and storage firms for participating in the time studies.

Figures 9 and 11 are used through courtesy of Pullman-Standard Car Manufacturing Company, Chicago.

This study supplements the economic survey of rice transportation in Louisiana, Texas, and Arkansas, "Transportation of Rice in the South; An Economic Survey," by Ezekiel Limmer and Robert J. Byrne (in press).

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# SUMMARY

The combine-dryer method of harvesting moist rice is a bulk handling process and requires bulk storage facilities. Inadequate bulk storage capacity in Louisiana and Texas for all of the rice dried during the short harvest period compels the use of sack containers for part of the crop. However, additional bulk facilities have been constructed in recent years, and by June 1955, this type of facility comprised 59 percent of the total rough rice storage available in these 2 States. Arkansas has had 100 percent bulk storage for several years. It is predicted that Louisiana and Texas will also have 100 percent bulk storage capacity within a few years.

Time studies showed that an average of 24 man-hours are required to load and unload a boxcar (load) of 420 sacks of rough rice, each sack weighing approximately 162 pounds. For the same quantity of bulk rice in boxcars, 6 man-hours are required; in covered hopper cars, 4 man-hours. At $1.25 per man-hour the labor costs to load and unload cars are as follows: $30 for sacked rice in boxcars, $7.62 for bulk in boxcars, and $5.20 for bulk in covered hopper cars.

The hopper car unloading operations observed were, however, hampered by the limited capacity of the receiving pit beneath the track and of the conveyors for moving the rice from the receiving pit into the elevator. Unloading costs could be substantially reduced by increasing the capacity of the unloading facilities.

A car detention study of 2,886 boxcar loads of rough rice received in sacks and bulk by mills at Houston, Tex., during the 1954 harvest showed an average of 4.5 days of constructive and actual placement for unloading. A similar analysis was made by the Association of American Railroads of 57 boxcar loads of bulk rice received during October 1954 at mills in Jonesboro, Ark. The average placement for these 57 cars was 1.3 days. With few exceptions the hopper carloads of bulk rice received during 1954 by mills in Arkansas were placed and unloaded on the same day they arrived, and a few were loaded and unloaded twice in the same day.

The turnaround time of covered hopper cars in Arkansas was analyzed. On one railroad serving Stuttgart, Ark., 52 hoppers were made available for various periods during 1954, averaging 136 days. They produced 882 carloads. The average hopper car was loaded 17 times for an average turnaround of 8 days. The Association of American Railroads made a series of spot checks of 263 covered hopper carloads received at other points in Arkansas which showed a turnaround of 7.4 days. Comparable local data on boxcars were not available because the boxcar is a general purpose car, and the same boxcar is seldom restricted to special traffic as the specialized hopper car is. However, the AAR reports 16 days for the national average turnaround for boxcars.

Milling operations in 1953 and 1954 in Arkansas, with bulk receipts only and extensive use of covered hopper cars, were compared with those in Louisiana and Texas with approximately half sacked and half bulk receipts in boxcars only. In Arkansas, the milling schedules and outbound shipments of milled rice were scarcely affected by extra large rough rice receipts during the rush harvesting period. In Louisiana and Texas the milling operations and shipments of milled rice peaked sharply at harvest time. Therefore, and in addition to the faster turnaround of railroad cars by prompt placement and release of the inbound carload, it also appears that bulk shipment may have some influence in stabilizing milling schedules.

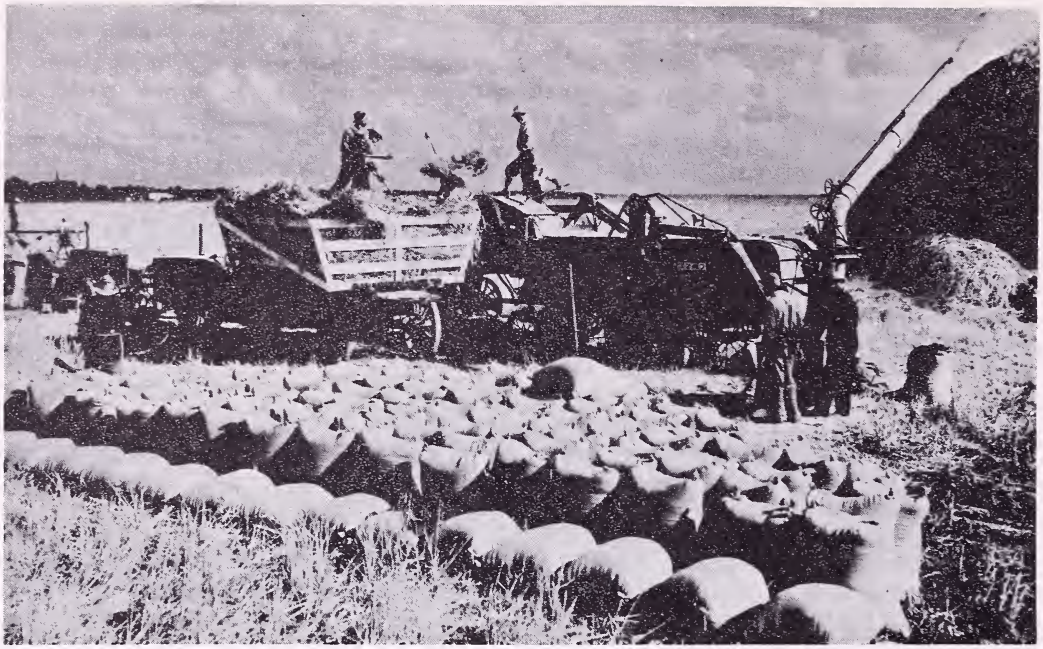

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Figure 1. --Threshing and sacking field dried rough rice.

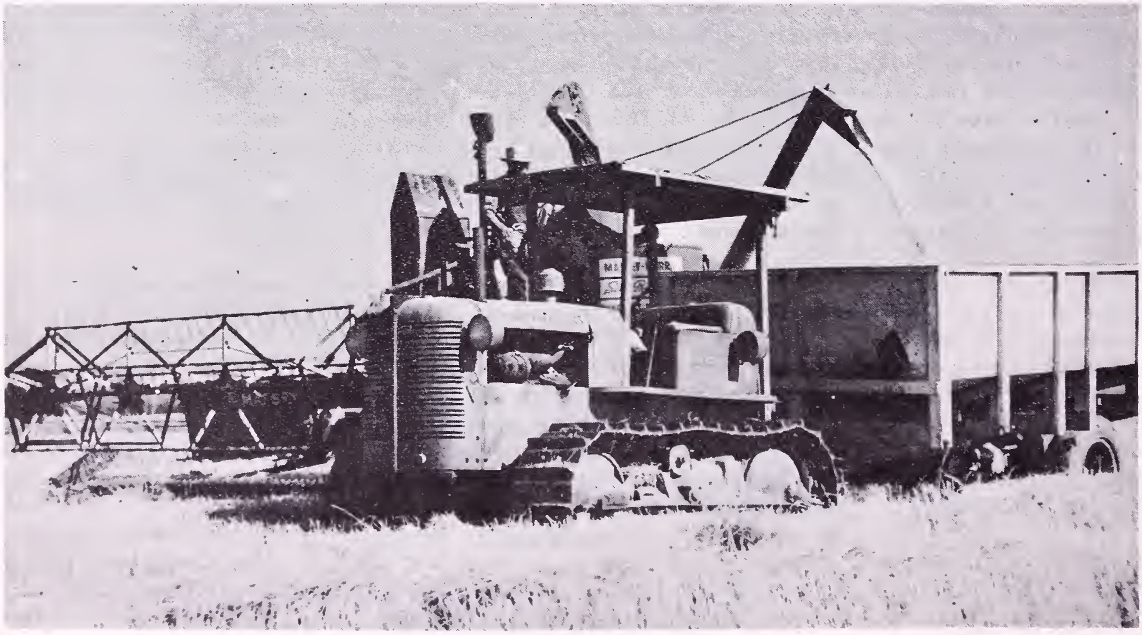

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Figure 2. --The combine cuts, threshes, and loads bulk moist rice in one operation.

# RAILROAD TRANSPORTATION OF ROUGH RICE IN LOUISIANA AND TEXAS

by

J. Edward Jay, transportation economist,
and Mark R. Enger, industrial engineer

## INTRODUCTION

The development of artificial rice drying facilities made it practical for farmers to use the grain combine to cut and thresh moist rice. This improved method of harvesting and drying is a bulk handling process. It has made the sacking of field-dried rice unnecessary, and created the need for bulk storage facilities. Substantial increases in bulk storage capacity in Louisiana and Texas introduced the opportunity to use covered hopper bottom cars to transport rough rice from bulk storage to rice mills. This study analyzes methods of loading and unloading sacked and bulk and compares boxcar and covered hopper car utilization in rough rice traffic.

Formerly, the binder cut and tied moist rice into bundles which dried in the field. After a few weeks of favorable weather the rice grains were sufficiently dry to be threshed and sacked, and were hauled to the mill or to a flat storage warehouse (fig. 1). Today, the grain combine cuts, threshes, and loads moist rice in one operation (fig. 2).

Artificial drying of bulk moist rice must begin within a few hours after it is cut and threshed. The moisture content is progressively reduced as the moist rice is dropped through columns of hot air several times to evaporate the moisture on the surface of each rice grain. Layover bins hold the partially dried rice for approximately 10 hours between the passes through the hot air chamber while internal moisture again comes to the grain surface. The drying process is repeated until the moisture content of the grain is reduced to approximately 13 percent.[1] Mechanical and gravity conveyors elevate and move the rice through a sequence of drying stages and then to bulk storage bins. When bulk storage facilities are not available adjacent to the dryer, the rice is conveyed to a sacking area.

Inadequate bulk storage capacity for the large volume of rough rice dried during the short harvest period compels the temporary use of sack containers in Louisiana and Texas. Considerable manual labor is required at the drying plant to fill and sew the sacks, stencil identification, and haul to a flat warehouse. Additional manual labor is employed at the warehouse to stack sacked rice properly for air circulation (fig. 3). It is estimated that the farmer pays from 20 to 40 percent more for sacks and sack handling than for bulk handling, depending upon the size of the sacks and whether new or used.[2] Consequently, the need for bulk storage facilities has been urgent. Sacks and flat warehouses become obsolete as farmers convert to combine-driers.

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[1] Southern Cooperative Series Bulletin No. 29, "Drying and Storage of Rough Rice," jointly issued by State agricultural experiment stations at College Station, Tex., Fayetteville, Ark., and Baton Rouge, La.

[2] U. S. Department of Agriculture Marketing Research Report No. 75, Nov. 1954, "An Economic Study of Rough Rice Storage in Southern States," page 30, states in part, ". . . The producer was required to pay for the cost of the sacks and this expense varied from 20 to 40 cents a sack, or about 25 cents per hundredweight sacked. Thus the total cost per unit for rice stored in flat warehouses was from 20 to 40 percent greater than the cost per unit when stored in bulk units."

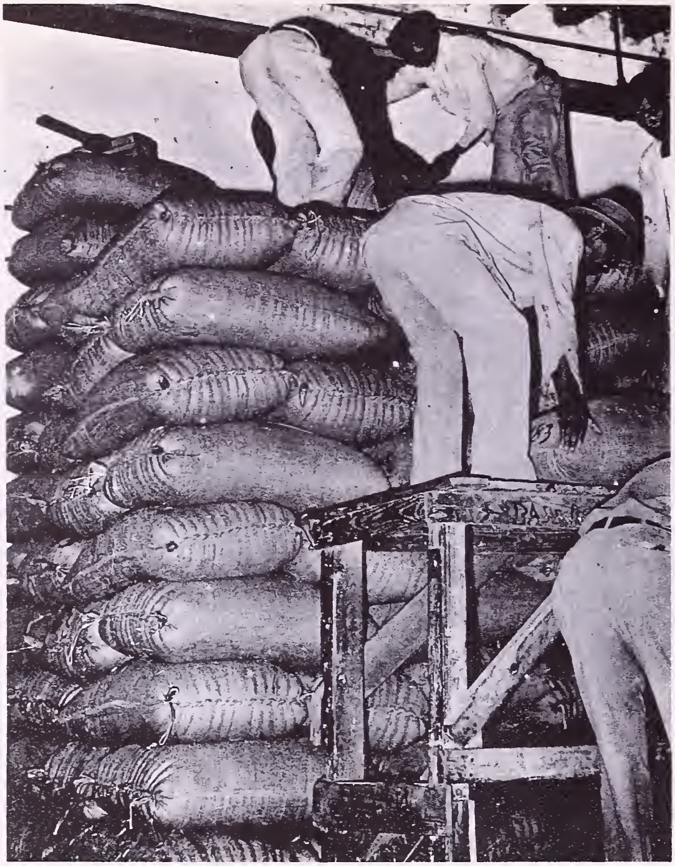

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Figure 3.--Stacking sacked rice in flat warehouse. One man of the 6-man crew is not shown.

## INCREASE IN BULK STORAGE CAPACITY

A substantial increase in bulk storage capacity is significant to the railroads since rough rice is shipped to the mills in the form in which it is stored. Table 1 shows increases in bulk storage facilities by producing areas in Louisiana and Texas during the 4 years ended June 1955. In Louisiana the increase since 1951 is 255 percent, and in Texas 80 percent. The combined increase is 152 percent, with bulk storage now comprising 59 percent of the total storage available for rough rice, bulk and sacked, in these 2 States. Arkansas has 100 percent bulk storage, except for seed rice. Additional bulk storage facilities under construction and planned for in Louisiana and Texas justify the prediction that these 2 States will also have 100 percent bulk storage in the near future.

## LOADING AND UNLOADING BOXCARS OF SACKED RICE

Sacks of rough rice, each weighing approximately 162 pounds, are loaded by manual labor with hand trucks or forklift trucks. Ten or more men are employed, depending upon the height of the stacked sacks in the flat warehouse and the distance the rice is hand-trucked to the railroad boxcar. Two to 4 of these men "break" the stacks and place 4 sacks on the hand truck (fig. 4). Two to 4 other men are inside the boxcar to unload the hand truck and arrange the load in the car (fig. 5). Other members of the crew are assigned to hand trucks or forklifts as needed to keep the loaders and unloaders busy. The forklift truck replaces 2 or 3 hand trucks by hauling 8 to 12 sacks on each trip. However, the same number of loaders and unloaders are required. Sample studies showed that approximately 35 sacks were loaded in cars per man-hour employed, using either the forklift or hand trucks.

Table 1.--Rough rice bulk storage capacity, by parish and county, in Louisiana and Texas in 1951 and as of June 30, 1955[1]

| State and parish | 1951 | | | 1955 | | | State and county | 1951 | | | 1955 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total storage | Bulk | Percent bulk | Total storage | Bulk | Percent bulk | | Total storage | Bulk | Percent bulk | Total storage | Bulk | Percent bulk |
| | *1,000 cwt.* | *1,000 cwt.* | | *1,000 cwt.* | *1,000 cwt.* | | | *1,000 cwt.* | *1,000 cwt.* | | *1,000 cwt.* | *1,000 cwt.* | |
| Louisiana: | | | | | | | Texas: | | | | | | |
| Acadia.... | 2,873 | 856 | 29.8 | 5,088 | 2,683 | 52.7 | Austin.... | 36 | 29 | 81.2 | 64 | 60 | 92.3 |
| Allen..... | 293 | 135 | 46.1 | 484 | 252 | 52.1 | Brazoria.. | 1,875 | 1,099 | 58.6 | 2,171 | 1,202 | 55.4 |
| Ascension. | --- | --- | --- | 84 | 33 | 38.6 | Calhoun... | 197 | 35 | 31.8 | 288 | 208 | 72.2 |
| Evangeline | 259 | --- | --- | 801 | 426 | 53.2 | Chambers.. | 438 | 162 | 37.0 | 556 | 375 | 67.5 |
| Calcasieu. | 702 | 43 | 6.2 | 2,193 | 1,224 | 55.8 | Colorado.. | 378 | 216 | 57.1 | 750 | 396 | 52.8 |
| East Car- | | | | | | | Harris.... | 1,078 | 406 | 37.6 | 2,144 | 979 | 45.6 |
| roll.... | --- | --- | --- | 76 | 76 | 100.0 | Fort Bend. | 53 | 46 | 87.3 | 226 | 212 | 93.8 |
| Iberia.... | --- | --- | --- | 162 | 19 | 12.0 | Jackson... | 530 | 399 | 75.3 | 1,283 | 832 | 64.9 |
| Jeff Davis | 2,114 | 975 | 46.1 | 3,122 | 1,975 | 63.3 | Jefferson. | 1,141 | 839 | 73.5 | 1,384 | 1,064 | 76.9 |
| Orleans... | --- | --- | --- | 453 | 200 | 44.2 | Liberty... | 1,014 | 502 | 49.4 | 1,445 | 648 | 44.9 |
| St. Landry | 819 | 257 | 31.3 | 1,003 | 449 | 44.7 | Matagorda. | 506 | --- | --- | 822 | 428 | 52.0 |
| Vermilion. | 4,074 | 724 | 17.8 | 3,269 | 2,147 | 65.7 | Orange.... | 244 | 40 | 16.4 | 365 | 100 | 27.4 |
| W. Baton | | | | | | | Waller.... | 249 | 152 | 61.0 | 531 | 531 | 100.0 |
| Rouge... | --- | --- | --- | 1,145 | 1,145 | 100.0 | Wharton... | 1,040 | 351 | 33.7 | 1,451 | 694 | 47.8 |
| Total... | 11,134 | 2,990 | 26.9 | 17,880 | 10,629 | 59.4 | Total... | 8,779 | 4,276 | 50.1 | 13,480 | 7,729 | 57.3 |

[1] Does not include bulk capacity of garner or conditioning bins used in the drying process.

Source: The 1951 bulk storage data were obtained from the field reports used to compile storage statistics in USDA Marketing Research Report No. 75 (supra); 1955 bulk storage data for Louisiana were furnished by Louisiana Warehouse Commission; Texas data furnished by individual county agents for the counties shown, and the Agricultural Extension Service, College Station, Tex.

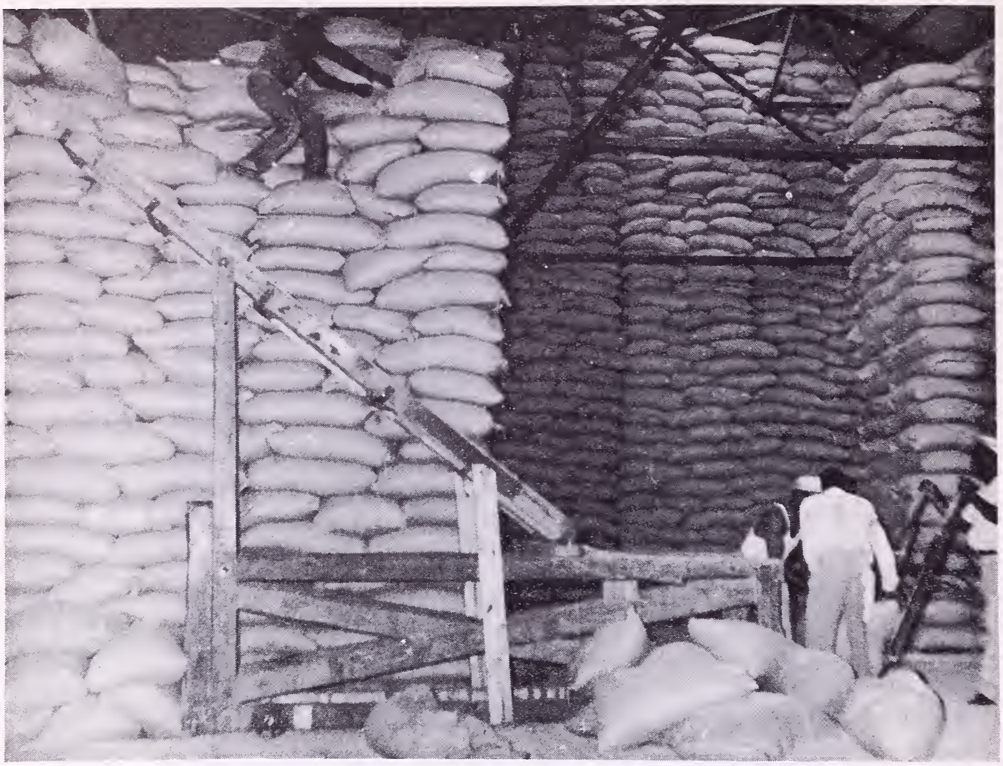

Figure 4.--Breaking the stacks of sacked rice and loading hand trucks. BN-2850

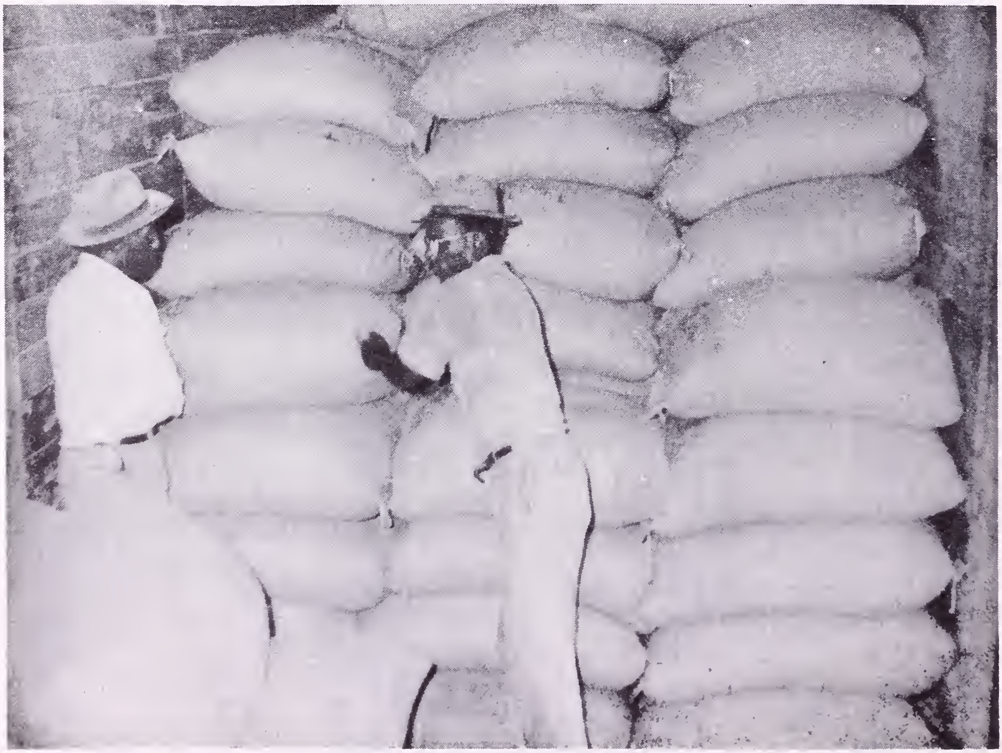

Figure 5.--Stacking sacked rough rice in boxcar. BN-2851

Rough rice received in sacks at the mill must eventually be restored to bulk form for milling. This is generally accomplished early by emptying the sacks as part of the unloading operation. One method is to empty the sack into a portable hopper attached to the boxcar door at floor level. The bulk rice then flows into the trough of a screw conveyor located several inches above the ground parallel with the railroad track. When unloading is completed the portable hopper is moved to another carload. A few mills have permanent pit receivers in the ground covered with grating. Rice grains poured from the sacks fall through the grating into the screw conveyor at the bottom of the pit. The screw conveyor carries them into the mill.

From 4 to 7 men are employed to unload sacked rice from boxcars. On a typical 4-man crew, 1 man opens the sack and stands it upright on the hand truck. The trucker hauls this opened sack several feet to the car doorway and drops it to spill the top half of the sack into the portable hopper. A third man completely empties the sack and arranges the empty sacks into bundles to be used again. The fourth man assists in pulling down the sacks. A crew may be increased to 7 men by adding another sack opener, a trucker, and a utility man. Opening the sack takes the most time; its difficulty depends upon whether the sack was closed by hand or by the machine. Machine stitched sacks are more difficult to open. Variations in the unloading routine are made according to the skill and teamwork of the crew. In the time studies, the extremes in range were 23 and 44 sacks per man-hour. It is estimated that a better than average crew will unload 35 sacks per man-hour.

## LOADING AND UNLOADING BOXCARS OF BULK ROUGH RICE

With few exceptions bulk rough rice is loaded into railroad cars by mechanically elevating the rice to an overhead measuring hopper, than releasing it through a gravity spout into the car (fig. 6). Two men inspect the boxcar, make such repairs as are necessary, install grain doors, and place the spout. This preparatory work usually requires from 1 to 1-1/2 hours, approximately the same length of time required to fill a car through the gravity spout. While preparing the next empty boxcar for loading, 1 of the 2 men will occasionally redirect the spout discharging in the previously prepared boxcar. This is done by moving the spout sideways with a lever attached to the top grain board (fig. 6). The time to load a car is determined by the rate of flow through the gravity spout, with occasional interruptions to shift the spout.

Any of the following methods are used by rice mills to unload bulk rough rice from boxcars: (1) The suction hose, (2) power shovel, and (3) the wheeled hand scoop. The suction hose had the best performance in the sample study; with it 136 barrels were unloaded per man-hour. The power shovel was second at 120 barrels per man-hour. Of these 2 powered methods the power shovel has a lower installation, maintenance, and operation cost. Higher maintenance and operating cost for the suction hose is attributed to air leaks from abrasion by silica in the rice hulls. The lowest output of 84 barrels per man-hour was obtained with the wheeled hand scoop, but this method is widely used. The comparison is tabulated in table 2, with performance expressed in the "barrel" unit (162 pounds).

Table 2.--Comparison of methods of unloading bulk rough rice from boxcars

| Method | Barrels | Barrels per man-hour | | | Men utilized |
|---|---|---|---|---|---|
| | | High | Low | Average | |
| | *Number* | *Number* | *Number* | *Number* | *Number* |
| Suction hose.............. | 5,282 | 193 | 68 | 136 | [1] 2.5 |
| Power shovel............. | 1,445 | 138 | 98 | 120 | [2] 4 |
| Hand scoop............... | 4,060 | 95 | 66 | 84 | [2] 5 |

[1] Mechanic held available half-time to close occasional air leaks and to assist in disconnecting and relocating the suction hose.

[2] Includes one unloader for rest and relief during nonstop work.

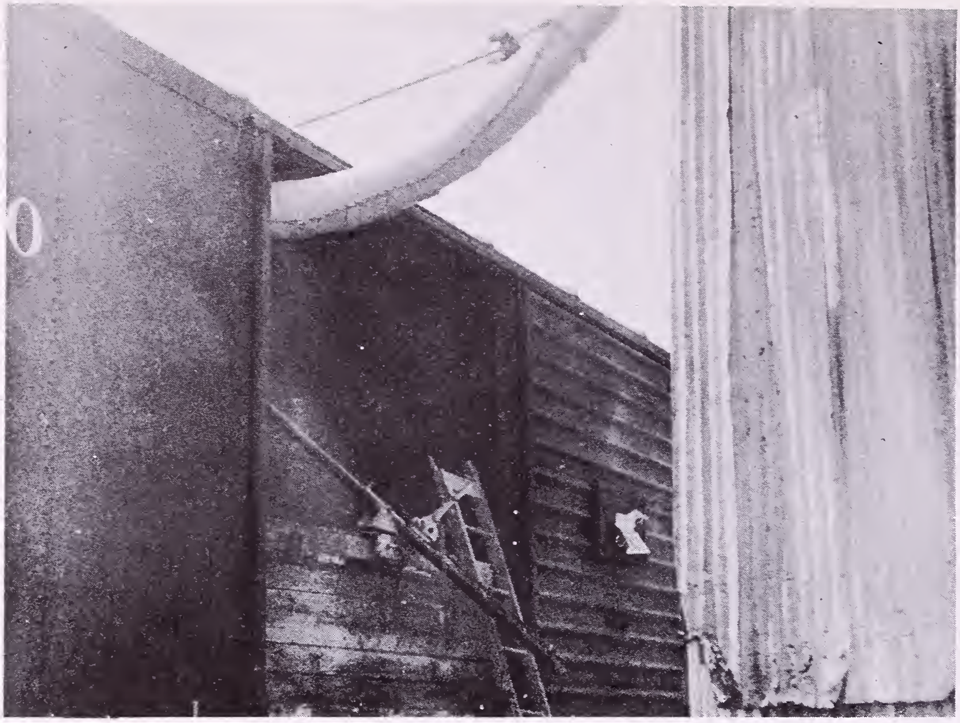

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Figure 6.--Bulk loading rough rice into prepared boxcar.

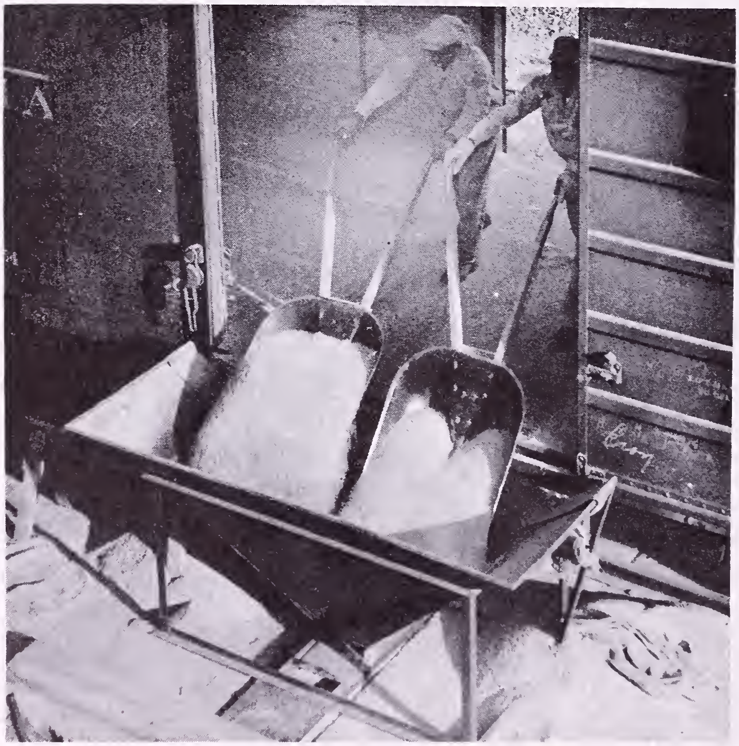

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Figure 7.--Unloading rice into portable hopper with wheeled hand scoops.

## LOADING AND UNLOADING COVERED HOPPER BOTTOM CARS

The procedure for loading covered hopper cars is similar to that followed in loading boxcars. Two men are needed to move the empty car into position. Occasionally the 2 men also erect, adjust, or strengthen the improvised A-frame support for the spout (fig. 8). A regular routine is for one or both of the men to get inside the hopper car to inspect, clean, and close leaks. When the car is ready, the flexible end of the spout is inserted in one of the several hatches, and the gravity flow of rough rice started. When a hatch area is filled, the flow is stopped and the spout is relocated and secured in another hatch. More often both men are used to shift the spout, one shutting off the rice flow and the other moving the spout after it has emptied. These 2 men usually alternate on these tasks. Improved methods could be devised with further experience. For example, the spout can be supported by a permanent swivel instead of the A-frame, and the flow can be stopped at the overhead hopper by a control switch near the hand hold on the spout as indicated in figure 9. In fact, at a few elevators it was found practical to load 2 hopper cars simultaneously with 2 men, 2 spouts, and 2 A-frames, the 2 men working together only when moving an empty car.

Bulk rough rice flows through outlets at the bottom of the hopper car into a chute between the rails leading into an underground pit (fig. 10). A screw conveyor moves the rice from the pit into the mill. Chutes and underground pits thus far constructed have been improvised to accommodate both the boxcar and the covered hopper unloading. In most instances the chute and pit extend under the track into the conveyor system. The cost of installation has varied between $300 and $2,500, largely depending upon the changes necessary in the existing screw conveyor.

Two men are employed to move the loaded hopper by cable and windlass, placing the outlet directly over the chute. The car is moved several feet for each of the other outlets, and completely unloaded in 30 to 50 minutes with 14-inch and 12-inch screw conveyors, respectively. In the installations observed at rice mills the release of rice from the hopper cars had to be adjusted to the ability of the screw conveyor to remove it from the pit. At grain elevators where the grain is moved from the pit to the elevator on a conveyor belt of greater capacity, a covered hopper carload can be unloaded in a few minutes.[3] The same method might be adopted for rough rice. If covered hoppers were used universally, perhaps full car-length pits of approximately 3,000 cubic feet capacity might be built to discharge all outlets simultaneously, making it worthwhile for the locomotive to await unloading. The released hopper could be returned earlier for reloading, and further reduce the turnaround time of that hopper car.[4] The additional pit capacity would also be useful for temporary bulk storage.

## LABOR COST COMPARISONS

It costs approximately $30 to load and unload 420 sacks of rough rice from a boxcar. This is 4 times as much as it costs to load and unload the same quantity in bulk. A covered hopper car of the type shown in figure 11 holds up to 90,000 pounds of rough rice, approximately 20 percent more than a boxcar load. On a comparable basis and allowing for fewer placement operations for several hopper cars, the cost should be about half that of the boxcar load of bulk rice. The man-hour requirements for a typical carload of 420 sacks of rough rice, and its equivalent of 68,000 pounds of bulk are compared in table 3.

The above comparisons were based upon labor costs only since the mills which used mechanized unloading equipment such as power shovels and suction systems had built to their individual requirements. As a result no equipment cost figures were available that

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[3] Hudson, William H. The Transportation and Handling of Grain by Motor Truck in the Southwest, p. 50, Prod. & Mktg. Admin. U. S. Dept. Agr., May 1952.

[4] "Turnaround time" means the number of days that elapse from the time a car is loaded until it is loaded again.

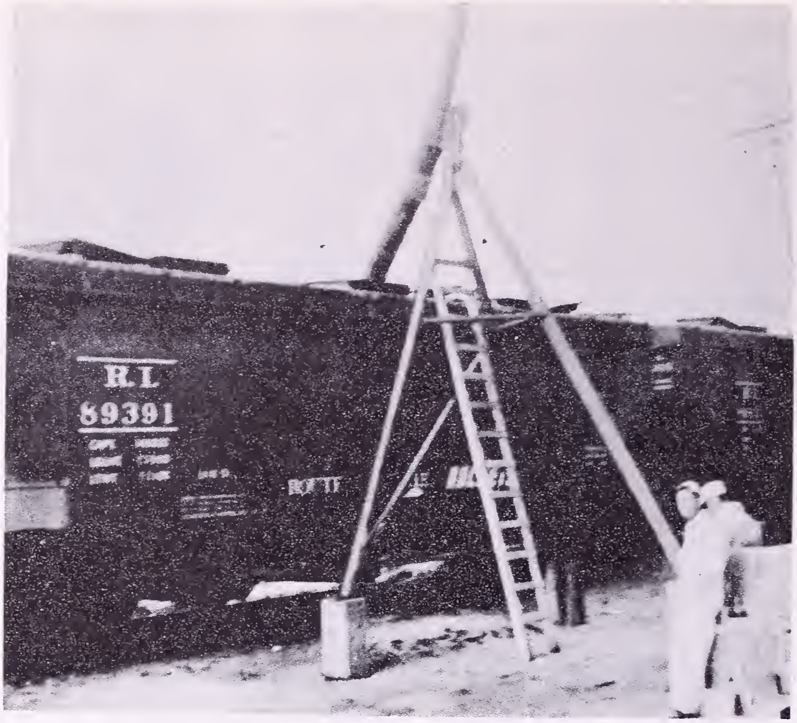

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Figure 8. --A-frame supporting gravity spout loading rice into hopper car.

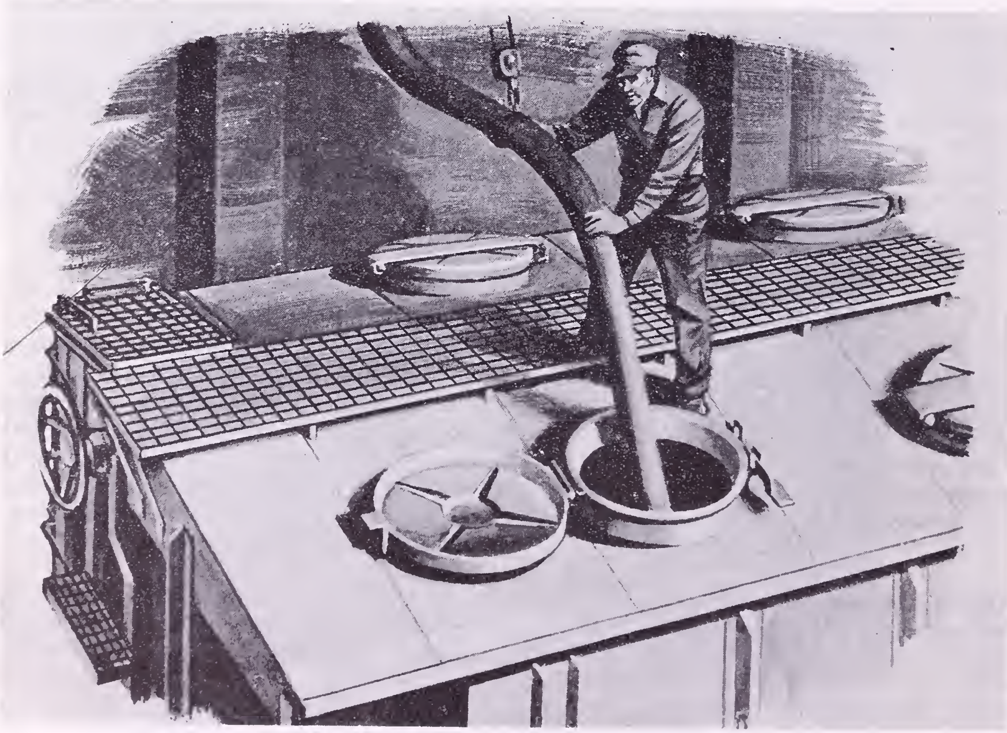

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Figure 9. --One man loads a covered hopper car. (Artist's sketch)

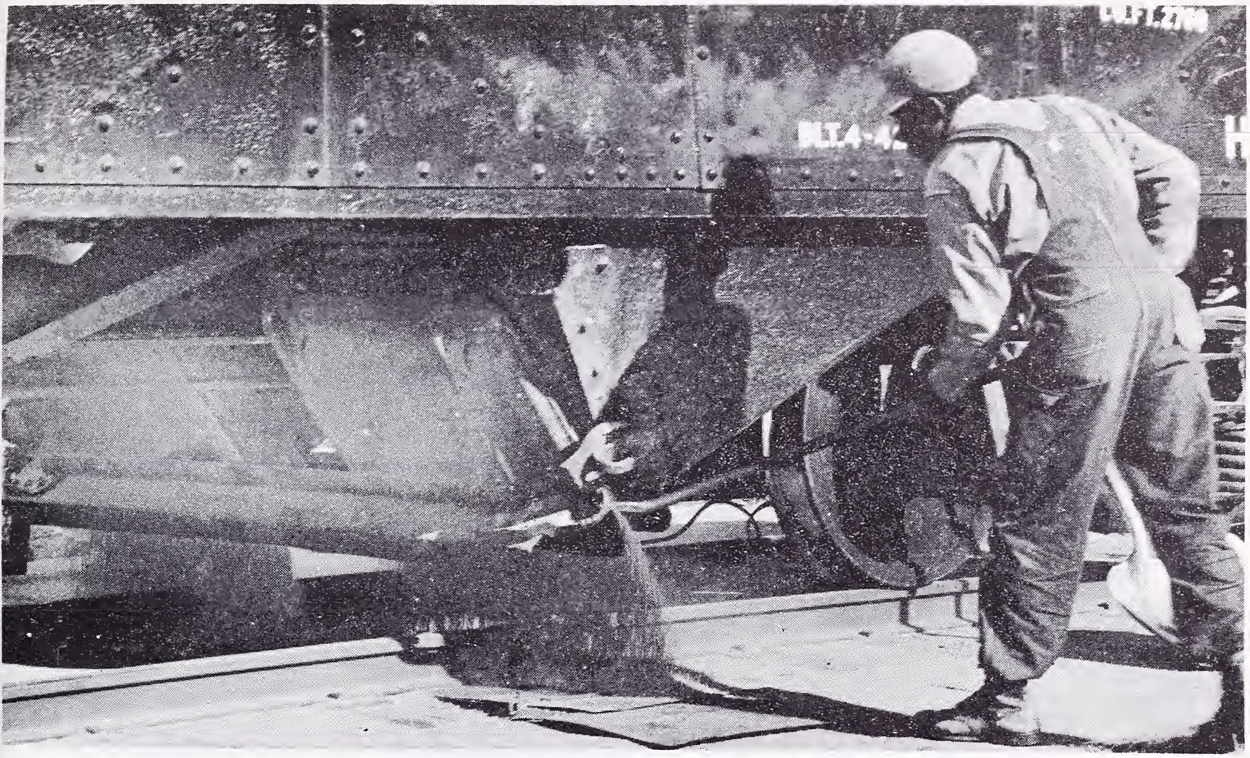

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Figure 10.--Opening outlet to discharge rice from covered hopper car.

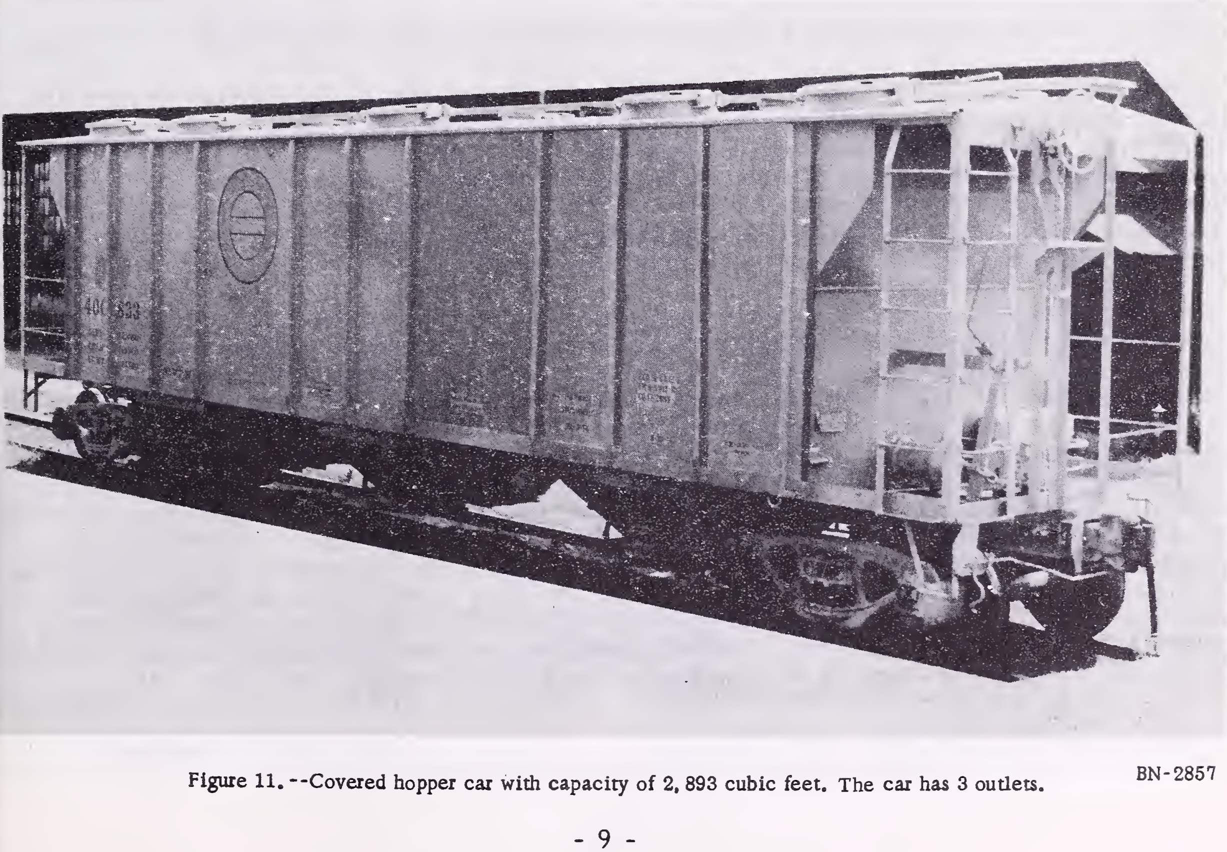

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Figure 11.--Covered hopper car with capacity of 2,893 cubic feet. The car has 3 outlets.

were representative of the industry. If a change in unloading method in a plant is being considered, equipment costs as well as labor costs would have to be figured for each individual plant layout, taking into account all systems available and production desired.

Table 3.--Comparison of labor costs to load and unload equivalent amounts of sacked and bulk rough rice, by type of car and method

| Type of car and method | Sacks, or bulk equivalent, per man-hour | Man-hours per carload | Labor cost at $1.25 per man-hour |
|---|---|---|---|
| Boxcar, 420 sacks: | | | *Dollars* |
| Loading | 35 | 12 | 15.00 |
| Unloading | 35 | 12 | 15.00 |
| Total | | 24 | 30.00 |
| Boxcar, 68,000 lb. bulk: | | | |
| Loading | 175 | 2.4 | 3.00 |
| Unloading | [1] 113 | 3.7 | 4.62 |
| Total | | 6.1 | 7.62 |
| Hopper cars, 68,000 lb. bulk: | | | |
| Loading | [2] 175 | 2.4 | 3.00 |
| Unloading | 265 | 1.6 | 2.20 |
| Total | | 4.0 | 5.20 |

[1] Average of 3 methods: suction hose, power shovel, and hand scoop.

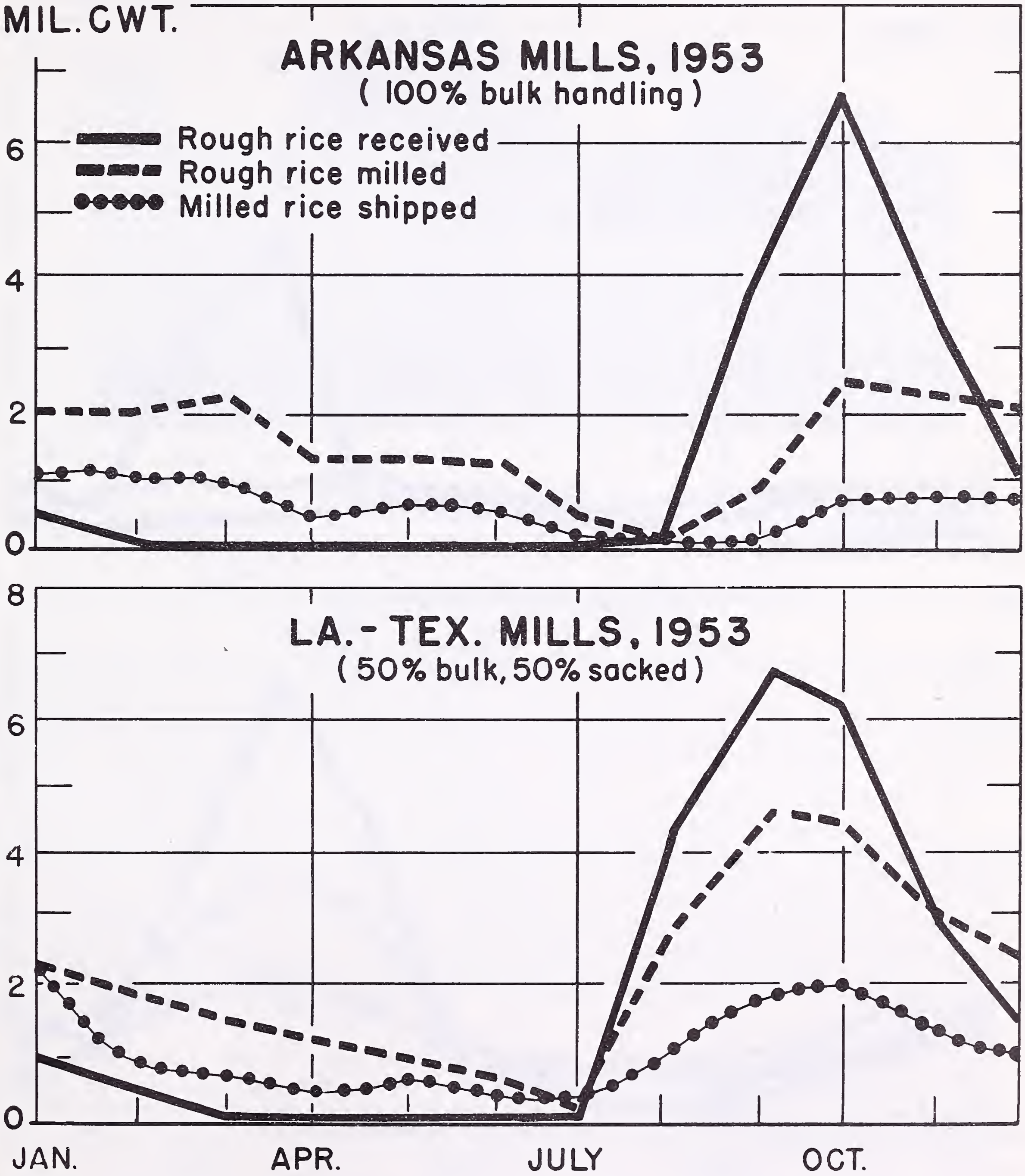
[2] Based upon 2 men generally used; use of only 1 man would reduce the cost per man-hour almost half.

## EFFECT OF BULK HANDLING ON MILLING OPERATIONS

Principal milling operations are (1) receiving rough rice from country dryers and storage points, (2) milling it, and (3) shipping the milled rice to the consuming trade. Rough rice receipts are large during the short harvest period, and bulk storage space made available by shipments of milled rice during the preceding months is used. Since domestic consumption of rice is year-round, milling operations and shipments of milled rice should be fairly constant throughout the year. Consequently, these two milling operations are not directly affected by harvesting operations.

The principal milling operations were analyzed to observe the effect, if any, of bulk storage, handling, and transportation. Arkansas rice is held in bulk storage facilities, and covered hopper cars are used extensively. Bulk storage is available for approximately half of the combined rice production in Louisiana and Texas, where covered hopper cars are not used. A comparison of milling operations in these two producing areas is shown in figures 12 and 13, for the years 1953 and 1954. The 2 years had different production and market situations. The year 1953 had a normal production and an excellent export market, while 1954 had a larger production and moderate export market. In both years, milling and shipping operations in Arkansas were mildly affected by the harvest season, while the mills in Louisiana and Texas felt the impact of the harvesting period. Increased unloading activities, and at the same time increased outbound shipments of milled rice, cause congestion of individual mills and further delays prompt placement and relase of boxcars. Undoubtedly, the intensive milling operations contributed to the excess car-days of detention experienced at Houston, Tex. (fig. 14).

# EFFECT OF BULK STORAGE AND TRANSPORTATION UPON PRINCIPAL RICE MILLING OPERATIONS



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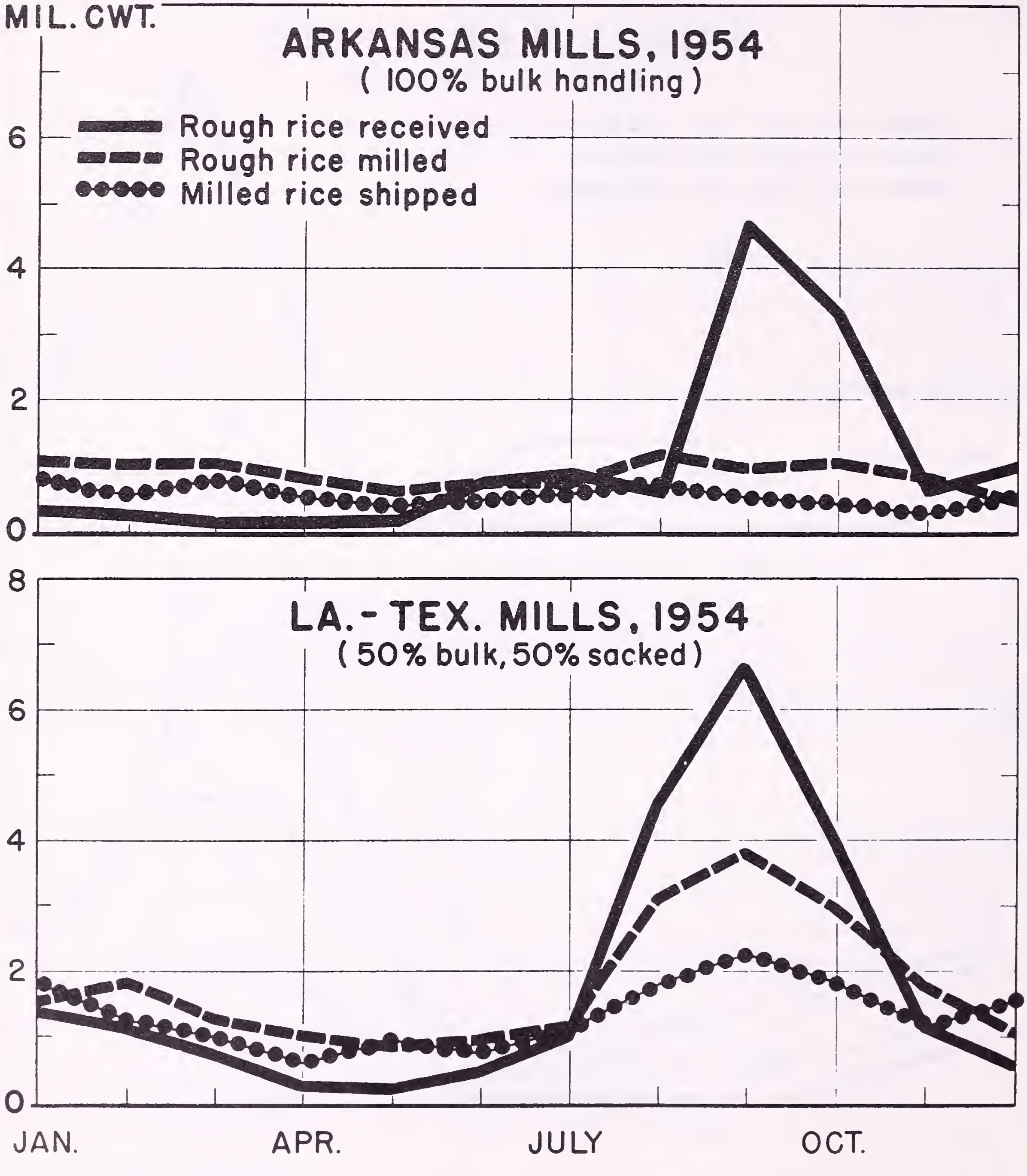
# EFFECT OF BULK STORAGE AND TRANSPORTATION UPON PRINCIPAL RICE MILLING OPERATIONS



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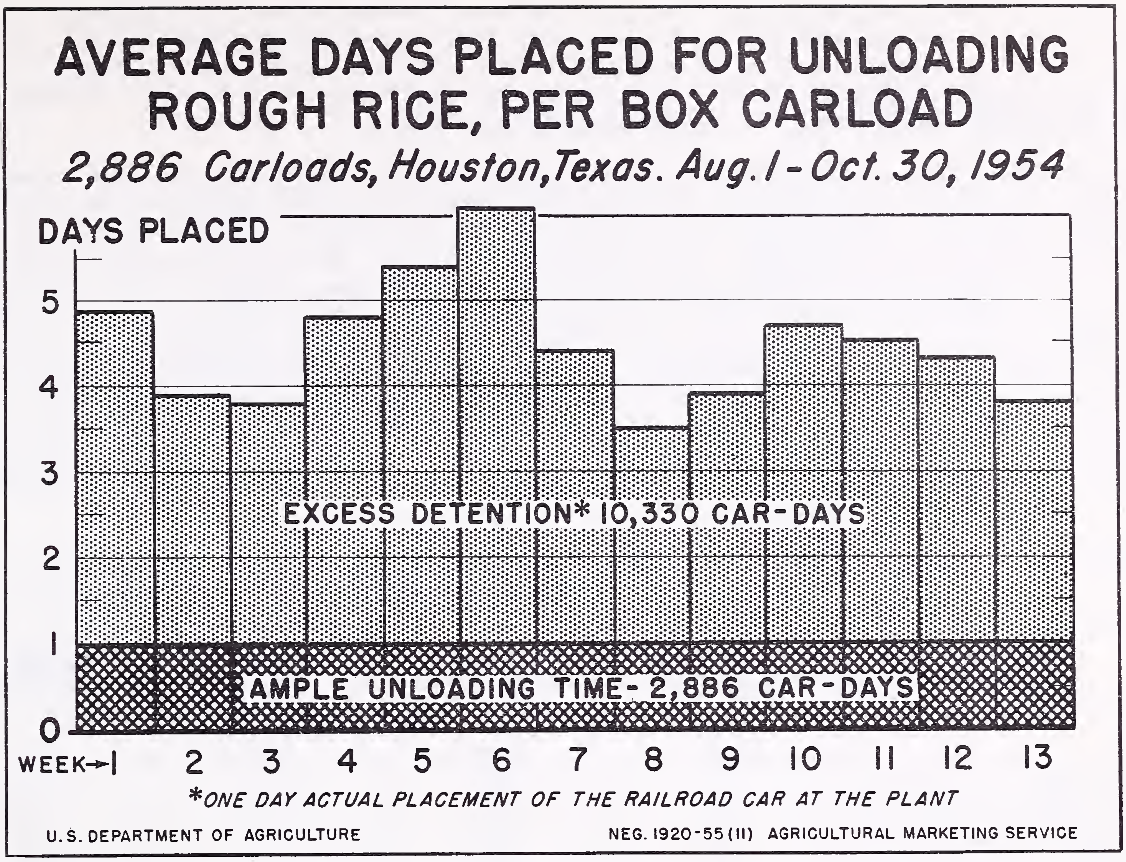

AVERAGE DAYS PLACED FOR UNLOADING ROUGH RICE, PER BOX CARLOAD

*2,886 Carloads, Houston, Texas. Aug. 1 - Oct. 30, 1954*

**ONE DAY ACTUAL PLACEMENT OF THE RAILROAD CAR AT THE PLANT*

U.S. DEPARTMENT OF AGRICULTURE NEG. 1920-55 (11) AGRICULTURAL MARKETING SERVICE

## BETTER CAR UTILIZATION BY BULK HANDLING AND COVERED HOPPER CARS

Demurrage records covering all rough rice carload shipments received in sacks and in bulk by rice mills in Houston, Tex., during the 1954 harvest season were examined. Since the storage warehouses contained approximately half sacked and half bulk, it is presumed that sacked and bulk shipments were received in nearly the same proportion. In August, September, and October, 2,886 boxcar loads of sacked and bulk shipments were constructively and actually placed for unloading for a total of 13,216 car-days. See figure 14. Freight Tariff 4-C, I.C.C. 4677, Item 610, Section D, reads in part: "Note 1. 'Actual placement' is made when a car is placed in an accessible position for... unloading... If such placing is prevented by any cause attributable to... consignee, it shall be considered constructively placed without notice." The average period of placement was 4.5 days per carload. In contrast, an average of 1.3 days' placement was found for 57 boxcar loads in a spot check made at Jonesboro, Ark., by the AAR during October 1954. Although this sample was comparatively small, it is understood to be common performance during the harvest season in Arkansas. It seems, therefore, that receiving rough rice in bulk instead of sacks, as indicated in figures 12 and 13, contributes materially to better car utilization.

The increases in bulk storage capacity in Louisiana and Texas introduce the opportunity for railroads and the rice mills to consider using covered hopper cars for rough rice traffic in these two States. The covered hopper is designed for granular bulk flow commodities, particularly those products which are vulnerable to damage by excessive moisture. The maximum tolerance of 13 percent moisture content makes rough rice especially suitable for covered hopper cars. Also, the more efficient and economical bulk-flow features extend the bulk handling process of the combine-dryer method of harvesting. This extension would reduce the high cost of loading and unloading boxcars.

The volume of railroad traffic in commodities suitable for covered hoppers is small and seasonal compared with the traffic available for the general purpose boxcar. Moreover, a covered hopper costs somewhat more than a boxcar. From the railroads' standpoint the rough rice traffic should be fairly steady, and the covered hoppers assigned must be loaded, released, and reloaded promptly.

The use of covered hopper cars instead of boxcars for rough rice is more economical for railroads in rice producing areas that have completely converted to bulk storage and handling. Arkansas, for example, uses bulk storage entirely for milling rice and uses covered hopper cars extensively. The utilization of hopper cars by rice mills in Stuttgart, Ark., was analyzed from billing records for the calendar year 1954. A total of 52 hoppers were made available for 7,094 car-days and produced 882 carloads. The average availability per hopper car was 136 days. The range of loadings was from 25 to 177 loadings. The average number of loadings per hopper car was 17, providing an average turnaround of 8 days. Various publications and reports issued by the Car Service Division, Association of American Railroads, show the average turnaround time of boxcars to be 16 days. In 9 instances during the peak harvesting period in August, a hopper car was loaded twice on the same day, according to billing dates. The results are shown in table 4.

Table 4.--Utilization of hopper cars in the movement of rough rice by one railroad serving rice mills at Stuttgart, Ark., 1954

| Year and month | Hopper cars assigned[1] | Car-days available | Times loaded | Average turnaround |
|---|---|---|---|---|
| 1954 | *Number* | *Number* | *Number* | *Days* |
| January | 11 | 290 | 34 | 8.5 |
| February | 20 | 428 | 52 | 8.2 |
| March | 23 | 583 | 75 | 7.6 |
| April | 19 | 400 | 32 | 12.5 |
| May | 31 | 572 | 44 | 13.0 |
| June | 29 | 870 | 177 | 4.9 |
| July | 28 | 868 | 118 | 7.2 |
| August | 29 | 883 | 140 | 6.2 |
| September | 13 | 390 | 25 | 15.6 |
| October | 37 | 906 | 93 | 9.7 |
| November | 25 | 561 | 39 | 14.4 |
| December | 19 | 343 | 53 | 6.4 |
| Total or average | 52 | 7,094 | 882 | 8.0 |

[1] The number of days individual hopper cars were available for rice traffic varied, some the entire month, then for a limited number of days a month, and some for several months.

The Association of American Railroads made 7 spot checks covering a total of 263 hopper carload movements of rough rice on other railroads in Arkansas during October 1954. The data showed an average of 3 days between the billing date and the date unloaded, and 1 day after unloading until forwarded empty for reloading (table 5). The complete turnaround time was also obtained for 67 of the 263 movements, and showed an average of 7.4 days between loadings, almost the same turnaround shown in table 4.

Comparable data covering the utilization of boxcars for the movement of rough rice in Arkansas are not available, because boxcars are used in general service and specific boxcars were not held or restricted to local rough rice traffic as were the specialized hopper cars.

Table 5.--Sample spot checks made by the Association of American Railroads checking covered hopper car utilization, various points, Arkansas

| Sample | Carloads | Elapsed days from the billing date until unloaded | Elapsed days from unloading date until forwarded empty |
|---|---|---|---|
| | *Number* | *Number* | *Number* |
| A........... | 39 | 2.4 | 1.5 |
| B........... | 51 | 2.9 | .8 |
| C........... | 12 | 3.8 | 1.1 |
| D........... | 49 | 4.7 | 1.5 |
| E........... | 61 | 2.4 | .7 |
| F........... | 32 | 2.6 | .7 |
| G........... | 19 | 2.8 | 1.2 |
| Total or average | 263 | 3.0 | 1.0 |

It is likely that the turnaround time of boxcars in local rough rice service would not be as great as the national average of 16 days.

The shorter turnaround time of the covered hopper leads one to expect that its utilization would be definitely superior to that of the boxcar in shuttle service.

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